# INDOOR AIR QUALITY ASSESSMENT

**Hopedale Junior/Senior High School**
**25 Adin Street**
**Hopedale, Massachusetts**

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
June, 2000

## Background/Introduction

At the request of a parent, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality at Hopedale Junior/Senior High School.

On March 30, 2000, a visit was made to this school by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to conduct an indoor air quality assessment. The school was previously visited by Cory Holmes, ER/IAQ Program, on March 20, 2000 to investigate concerns about pollutants generated by renovation activities and a report was issued (MDPH, 2000a).

The school is a two-story red brick structure with a basement built in 1929 (the 1929 building). The rear wing (currently under renovations) is a two-story building that was added in the 1960's. This school houses students in grades seven through twelve. The school contains general classrooms, science classrooms, art room, a woodshop, gymnasium, library and cafeteria.

This building has been evaluated by a number of private consultants since the summer of 1999. Baseline indoor air quality measurements prior to renovation activities were taken during the summer to measure airborne particulates, relative humidity, carbon monoxide and carbon dioxide while the school was unoccupied (A1 Spectrum Service, 1999a). A second round of air testing was conducted prior to the opening of school during late August/early September 1999 (A1 Spectrum Service, 1999b). This second round of testing occurred during renovations and while the building was occupied by school staff. Air tests taken by another consultant during the heating season (January 24, 2000 and March 14, 2000) indicated inadequate ventilation in occupied areas of the building based on carbon dioxide measurements (DEC, 2000a; DEC, 2000b). The school was occupied when these tests were taken.

## Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH8708 Thermo-Hygrometer. Air tests for carbon monoxide were taken with the Defender, Multi Gas Meter.

## Results

This school has a student population of approximately 400 and a staff of approximately 65. The tests were taken during normal operations at the school. Test results appear in Tables 1-4.

## Discussion

### Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million parts of air (ppm) in twenty-seven of thirty areas surveyed. These levels are indicative of an overall ventilation problem in the school. It is also noted that several classrooms were sparsely populated and/or had open windows during the assessment, which can greatly contribute to reduced carbon dioxide levels.

Fresh air in classrooms is supplied by a mechanical unit ventilator (univent) system (see Figure 1). Univents were off in the majority of classrooms surveyed.

Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building and return air through an air intake located at the base of each unit. The mixture of fresh and return air is drawn through a filter and a heating coil, and is then provided to classrooms from the univent by motorized fans through fresh air diffusers. In order for univents to provide fresh air as designed, they must be unblocked and remain free of obstructions. Importantly, these units must be activated and allowed to operate.

In an effort to prevent renovation generated pollutants from being entrained by univents of classrooms adjacent to the construction/renovations, flexible ductwork was installed over the fresh air intakes (see Picture 1). This ductwork extends over the edge of the building and terminates on the roof in a fan. While this temporary duct system will prevent the entrainment of pollutants from the renovation, it may not be sufficient to provide fresh air for these classrooms. Airflow decreases as the length of ductwork increases from ventilation fans. In addition, airflow is decreased roughly in half by every $90^{o}$ angle that exists in ductwork. Most univents fans are approximately 3 feet from the fresh air intake. While these univents would be sufficient to draw air from this distance, the installation of ductwork over twenty feet from the univent fans would limit the draw of fresh air into these classrooms. In addition, the ductwork contains over $270^{o}$ of angles. If the draw of fresh air by the univents at the fresh air intake were 100 percent, the introduction of the angles of this ductwork would reduce that draw to approximately 12.5 percent. Therefore the length of this ductwork combined with the angles within the ductwork would tend to limit the amount of fresh air that can be drawn by univents in the classrooms without some mechanical aid in addition to the rooftop unit. A break in this vent system (see Picture 2) and damage to the flexible ducts (see Picture 3) were also noted. Damage to this system may degrade the ability of the univents to draw fresh air as well as result in pollutants from the renovation areas to be entrained by operating univents and introduced into classrooms. The top floor of the 1929 building is serviced by a heating, ventilating and air-conditioning (HVAC) system that is connected to wall mounted vents by flexible ductwork in the attic.

Exhaust ventilation consists of a series of gravity feed wall vents (see Picture 4) that are connected by airshafts to sheltered vents on the roof. No airflow was detected from these vents. In addition, a number of these vents were blocked with boxes and other materials, that can prevent airflow. If this system is not operating to its original function, airflow from the outside (called backdrafting) can penetrate into classrooms, carrying dirt/debris within the airshafts into classrooms. This unintended airflow can make temperature and fresh air control by univents difficult. Each of the vents terminates on the roof in a chimney-like structure. The location of the rooftop termination of these exhaust vents could not be determined, but it appears that previous renovations may have sealed these vents. It appears that a single roof duct terminus exists on the roof of the original school building (see Picture 5). Whether all exhaust ducts converge at the cupola could not be determined. Examination of the blueprints of the original building is needed to determine this condition. If open to the outdoors, these shafts should be sealed in classrooms and at the roof level to prevent backdrafting as well as preventing pests (birds, rodents, etc.) from entering occupied areas via the ventilation shaft.

In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. Information concerning servicing and balancing of the systems was not available during the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (BOCA, 1993, SBBRS, 1997). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 70° F to 78 ° F, which was within the BEHA recommended comfort range. The BEHA recommends that indoor air temperatures be maintained in a range between 70 ° F to 78 ° F in order to provide for the comfort of building occupants. Often times temperature control is difficult in a building of this vintage. Temperature control can also be difficult to control in areas without mechanical exhaust ventilation. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in this building was below the BEHA recommended comfort range in the majority of areas sampled. Relative humidity measurements ranged from 14 to 32 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

**Microbial/Moisture Concerns**

A pre-1960's style refrigerator was noted in the science storeroom (See Picture 6). A strong musty odor was noted around the refrigerator. Upon opening, several materials including a box of supplies (see Picture 7) were found colonized with mold.

A hallway in the cafeteria contains an interior garden with living plants (see Picture 8). The internal garden appears to be in cement and it could not be determined if these planters have adequate drainage. Plants can be a source of pollen and mold, which can be a respiratory irritant to some individuals. Plants should be properly maintained and have adequate drainage. The presence of a built-in heating vent located in the front of the garden can serve to aerosolize particulates, pollen, dirt, mold and/or spores present in this planter.

**Other Concerns**

Several other conditions were noted during this assessment which can effect indoor air quality. Recommendations concerning methods of containment for renovations were previously made to the Hopedale School Department (MDPH, 2000a).

Of note are the conditions under which chemicals are stored in the chemistry classroom. The use of plastic flexible hoses as vent ducts allowing for the potential mixing of volatile organic compounds (VOCs) with acidic materials are not acceptable methods for storing hazardous materials. The connection of these flammables storage cabinets with these vent hoses have created conditions that pose an immediate danger to health and safety. This is due to of the breach of the integrity of the flameproof storage cabinet as well as the potential mixing of VOCs and strong acids. These concerns were reported to the Hopedale Fire Department in a letter dated April 20, 2000 (MDPH, 2000b)(see Appendix B). In many instances, improperly stored chemicals in this area pose a fire and safety hazard.

The following is a list of conditions of improperly stored materials that were found in the science wing:

1. A heavily corroded container of an unlabeled material is stored in the flameproof cabinet (see Picture 9).
2. The chemical storeroom contained an operating chemical hood. Stored in this chemical hood were several bottles of acids (see Picture 10). The handles to the window sash of the chemical hood are corroded, (see Picture 11) which indicates that chemical vapors have escaped from the chemical hood at some previous date to corrode the exterior of this equipment. The purpose of chemical hoods is to draw aerosolized chemical vapors and odors from the work area out of the building. Chemical hoods should not be used for storage of unattended materials because this equipment can be deactivated during off-hours (Rose, S. L., 1984). If the chemical hood is deactivated, off-gassing material can penetrate into adjacent areas. Chemical hoods should be on at all times that chemicals are within the equipment. It is also good chemical hygiene practice to return stock bottles back to the storage cabinet after use.
3. The interior walls underneath the shelves and doors of the flammable storage cabinet were heavily corroded, which can indicate off-gassing of chemicals from improperly sealed containers. Paper covers each shelf (see Picture 12). Paper can absorb chemicals and serve as a source of off-gassing for these materials.
4. The chemistry lab was observed to have an incubator. Incubators are used for growing biological samples and have a vent at the top of its case (see Picture 13).

Incubation should be done in an area with adequate local exhaust ventilation to prevent the spread of biological contamination from the incubators.

5. The storage closet of the science classroom had a number of mercury filled thermometers hanging on a nail just inside the door. An accidental bump to this equipment can result in an accidental discharge of mercury within the classroom environment.

It is highly recommended that a thorough inventory of chemicals in the science department be done to assess chemical storage and disposal in an appropriate manner consistent with Massachusetts hazardous waste laws.

The woodshop is located in the basement of the 1929 building. A wood odor was detected in the hallway near the shop area, where the hallway door to the woodshop was propped open. Woodshop doors should be closed to prevent dusts and odors from spreading to adjacent areas of the school.

Accumulated chalk dust was noted in several classrooms. The library contained exposed fiberglass insulation. Chalk dust is a fine particulate, which can become easily aerosolized. Fibers from exposed insulation can become airborne and serve as a source of skin, eye and respiratory irritation to certain individuals.

A number of classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs), (e.g. methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Several areas had dislodged ceiling tiles. Missing ceiling tiles can provide a means of egress for odors, fumes, dusts and vapors between rooms and floors. The movement of ceiling tiles can introduce dirt, dust and particulate matter into occupied areas of the school. These materials can be irritating to certain individuals.

## Conclusions/Recommendations

The conditions noted at Hopedale Junior/Senior High School raise a number of complex issues. The combination of the building design, maintenance, work hygiene practices and the condition of stored materials in the building can have an adverse impact on indoor air quality. In view of the findings at the time of this visit, the following recommendations are made:

1. Implement corrective actions recommended in letter concerning renovations as soon as possible (see Appendix A).
2. Implement corrective actions recommended in letter to the Hopedale Fire Department as soon as possible (see Appendix B).
3. Reseal flexible ductwork in construction area. Replace damaged flexible ductwork.
4. In order to increase the delivery of fresh air to classrooms connected to the flexible ductwork, consider the feasibility of installing ventilation fans between the air intake on the roof and the univents. Installation of several fans can aid the delivery of fresh air to the univents.
5. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Operate univents while classrooms are occupied

6. Consider restoring exhaust ventilation to classrooms. If not feasible, seal exhaust vents in classrooms as well as the roof to prevent backdrafting and the egress of dirt, dust and/or odors into occupied areas.
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all non-porous surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
8. Remove moldy materials from the science storeroom refrigerator. Defrost and clean the interior of this refrigerator with an appropriate antimicrobial agent, then wipe down afterwards with soap and water.
9. Have a chemical inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials. Obtain Material Safety Data Sheets (MSDS') for chemicals from manufacturers or suppliers.
10. Maintain these MSDS' and train individuals in the science department in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (MGL, 1983).

11. Remove plants from the indoor planter in the hallway and examine the base of the planter for appropriate drainage, water leaks and microbial growth. If microbial growth is present, disinfect non-porous surfaces with an appropriate antimicrobial agent.
12. Operate woodshop exhaust ventilation system during school hours. Consider providing additional exhaust vent connections for unvented wood dust generating machinery into the existing collection system. Keep woodshop hallway doors closed. Install weather stripping at the base of the wood shop door and along the doorframe.
13. Properly store chemicals and cleaning products.
14. Seal utility holes and replace missing ceiling tiles to prevent egress of odors, fumes and vapors between rooms and floors.
15. Clean chalk boards and chalk trays regularly to prevent the build-up of excessive chalk dust.
16. Seal/repair exposed fiberglass insulation in library.

## References

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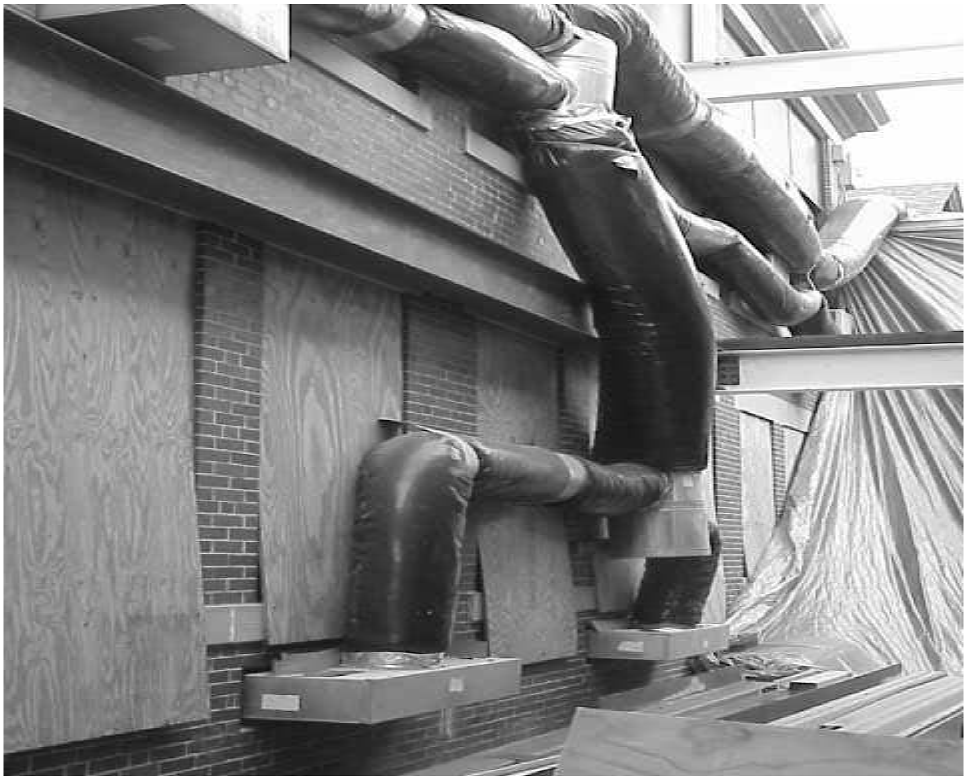
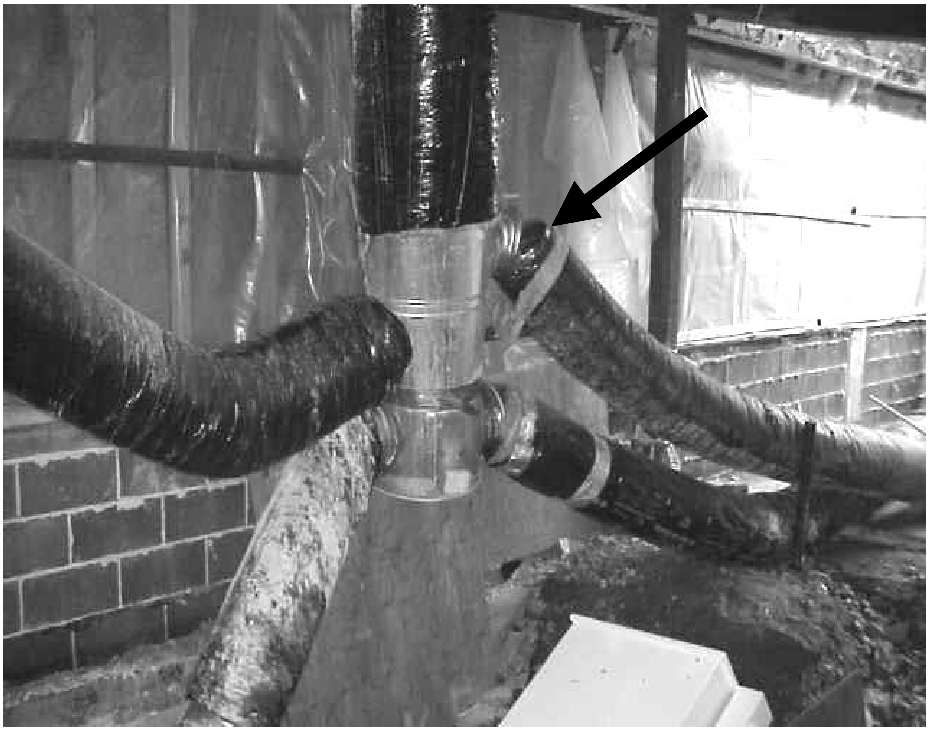
**Picture 1**



**Flexible Ductwork Attached to Univent Fresh Air Intakes to Avoid Entrainment of Construction/Renovation Pollutants**

**Picture 2**



**Fresh Air Supply Ductwork, Note Partially Detached Flexible Ductwork**

**Picture 3**

**Flexible Duct Crushed under Plywood**

**Picture 4**


**Gravity Exhaust Vent Blocked with Boxes**

**Picture 5**

Rooftop Exhaust Vent Terminus

**Exhaust Vent in Cupola of Building**

**Picture 6**

**Refrigerator in Science Storeroom**

**Picture 7**

**Mold Colonized Box in Refrigerator**

**Picture 8**

**Indoor Planter in Brick**

**Picture 9**


**Unlabelled, Corroded Container in Flameproof Cabinet**

**Picture 10**


**Chemical Hood in Chemistry Room with Stored Chemicals**

**Picture 11**

**Handle to Chemical Hood Sash, Note Corrosion**

**Picture 12**


**Paper Lining on Shelves of Flameproof Cabinet,**
**Note Discoloration of Paper That Indicate Leakage**

**Picture 13**


**Incubator in Chemistry Room**

**TABLE 1**

## Indoor Air Test Results –Hopedale Junior-Senior High School, Hopedale, MA – March 30, 2000

| Location | Carbon Monoxide *ppm | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake | Exhaust | |
| Outside (Background) | non-detectable | 447 | 58 | 25 | | | | | |
| Woodshop | non-detectable | 488 | 73 | 14 | 0 | yes | no | yes | exhaust off, door open |
| Kitchen | non-detectable | 521 | 73 | 15 | 3 | no | no | yes | |
| Basement Restroom | non-detectable | | | | | | no | yes | cigarette smoke odor |
| Room 105 | non-detectable | 958 | 71 | 21 | 13 | no | yes | yes | supply and exhaust off, door open |
| Room 107 | non-detectable | 1295 | 70 | 27 | 15 | no | yes | yes | supply and exhaust off, flameproof chemical hood |
| Room 109 | non-detectable | 1667 | 71 | 27 | 13 | no | yes | yes | supply and exhaust off, refrigerant |
| Room 110 | non-detectable | 1261 | 73 | 26 | 16 | yes | yes | yes | supply and exhaust off, exhaust blocked, door open |
| Room 108 | non-detectable | 1661 | 73 | 30 | 20 | yes | yes | yes | supply and exhaust off, door open |

*** ppm = parts per million parts of air**

**CT = water-damaged ceiling tiles**

**Comfort Guidelines**

| | |
|---|---|
| Carbon Dioxide - | < 600 ppm = preferred |
| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |

**TABLE 2**

## Indoor Air Test Results –Hopedale Junior-Senior High School, Hopedale, MA – March 30, 2000

| Location | Carbon Monoxide *ppm | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake | Exhaust | |
| Room 106 | non-detectable | 1588 | 74 | 20 | 12 | yes | yes | yes | supply and exhaust off, door open |
| Room 104 | non-detectable | 1181 | 73 | 23 | 20 | yes | yes | yes | supply and exhaust off, exhaust blocked by dryer, door open, |
| Room 202 | non-detectable | 1070 | 76 | 20 | 14 | no | no | no | door open |
| Room 203 | non-detectable | 1119 | 76 | 20 | 0 | no | no | yes | exhaust off, window mounted air conditioner (A/C), door open |
| Room 207 Library | non-detectable | 1179 | 76 | 20 | 17 | no | yes | yes | exhaust off, door open |
| Room 210 | non-detectable | 1802 | 75 | 31 | 0 | no | yes | yes | supply and exhaust off |
| Room 212 | non-detectable | 2000+ | 73 | 27 | 0 | no | yes | yes | supply and exhaust off |
| Room 211 | non-detectable | 1408 | 73 | 29 | 0 | yes | yes | yes | supply off, exhaust blocked by steel plate, door open |

*** ppm = parts per million parts of air**

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**Comfort Guidelines**

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|---|---|
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| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |

**TABLE 3**

## Indoor Air Test Results –Hopedale Junior-Senior High School, Hopedale, MA – March 30, 2000

| Location | Carbon Monoxide *ppm | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake | Exhaust | |
| Room 209 | non-detectable | 1068 | 72 | 23 | 5 | yes | yes | no | supply off, window open, chalk dust |
| Room 208 | non-detectable | 1691 | 74 | 32 | 21 | yes | yes | yes | supply off, exhaust blocked by basket, door open |
| Room 206 | non-detectable | 1688 | 75 | 26 | 19 | yes | yes | yes | supply off |
| Guidance Office | non-detectable | 1154 | 76 | 18 | 3 | yes | no | no | door open |
| Cafeteria | non-detectable | 1049 | 78 | 18 | 160+ | yes | yes (2) | no | supply off |
| Room 301 | non-detectable | 1246 | 74 | 20 | 18 | no | yes | yes | supply and exhaust off, door open |
| Room 302 | non-detectable | 1160 | 75 | 19 | 17 | yes | yes | yes | supply and exhaust off, window and door open |
| Room 304 | non-detectable | 1436 | 75 | 23 | 20 | no | yes | yes | supply and exhaust off |
| Room 303 | non-detectable | 1471 | 76 | 22 | 20 | yes | yes | yes | supply and exhaust off, window open |

*** ppm = parts per million parts of air**

**CT = water-damaged ceiling tiles**

**Comfort Guidelines**

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|---|---|
| Carbon Dioxide - | < 600 ppm = preferred |
| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |

**TABLE 4**

## Indoor Air Test Results –Hopedale Junior-Senior High School, Hopedale, MA – March 30, 2000

| Location | Carbon Monoxide *ppm | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake | Exhaust | |
| Room 205 | non-detectable | 1007 | 75 | 20 | 13 | yes | no | no | window and door open, 23 computers |
| Room 204 | non-detectable | 907 | 75 | 17 | 4 | yes | no | yes | exhaust blocked, 18 computers, door open |
| Pupil Personnel Service | non-detectable | 787 | 77 | 19 | 0 | yes | no | no | window and door open, missing ceiling tile, window mounted a/c |
| Pupil Personnel Service Restroom | non-detectable | | | | | | no | yes | exhaust off |
| Nurse's Office | non-detectable | 1170 | 76 | 20 | 5 | yes | no | no | window mounted a/c |
| Room 200 | non-detectable | 891 | 75 | 21 | 0 | yes | yes | yes | supply and exhaust off, window open, window mounted a/c |
| Room 201 | non-detectable | 981 | 75 | 18 | 30 | no | no | yes | exhaust off, chalk dust |

*** ppm = parts per million parts of air**

**CT = water-damaged ceiling tiles**

**Comfort Guidelines**

| | |
|---|---|
| Carbon Dioxide - | < 600 ppm = preferred |
| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |

# The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
Bureau of Environmental Health Assessment
250 Washington Street, Boston, MA 02108-4619




April 20, 2000

Scott Garland, Chief
Hopedale Fire Department
40 Dutcher Street
Hopedale, MA 01747

Dear Chief Garland,

The Massachusetts Department of Public Health, Bureau of Environmental Health Assessment conducted an indoor air quality assessment at the Hopedale Junior/Senior High School on March 29, 2000. During the course of this assessment (conducted with Leonard Izzo of the Hopedale Board of Health) conditions in chemistry classrooms at the high school were evaluated. This area has a flammables storage cabinet that contains a number of volatile organic compounds (VOCs). Of concern is the connection of this cabinet to the ductwork of the chemical hood in this classroom by a flexible plastic hose (see Pictures 1 through 3).

As you know, according to the National Fire Protection Association (NFPA), it is recommended that flammables storage cabinets be constructed in a manner to prevent fire from coming in contact with stored chemicals. In addition, while it is recommended that if a flammables storage cabinet is connected to a vent system, the vent system should not be constructed in a manner to provide an oxygen source to the interior of the cabinet and it must be vented directly outdoors and in a manner not to compromise the specific performance of the cabinet (NFPA, 1996).

It appears that the purpose of the hoses shown in Pictures 1 through 3 is to draw evaporating VOCs from the cabinets. If a fire were to occur in this storeroom, these plastic hoses would readily melt and expose the VOCs contained in the cabinet to fire, which can then serve as a mechanism to spread fire. The NFPA does not require venting in flammable storage cabinets.

The connection of these flammables storage cabinets with these vent hoses have, in the BEHA's opinion, created conditions that are an immediate danger to health and safety because of the breach of the integrity of the flammables storage cabinet.

We recommend that the following actions be taken to remediate this hazard:

1. Disconnect the flexible hose from the flammables storage cabinet. Reseal the bungholes of the flammables storage cabinet with the original bungs. If the original bungs cannot be located, contact the cabinet manufacturer to obtain replacements.

2. Reseal the ductwork of the chemical hood to render this duct airtight.

We recommended that these steps be taken as soon as possible. We hope you find this information helpful. Please feel free to contact us at (617) 624-5757.

Sincerely,

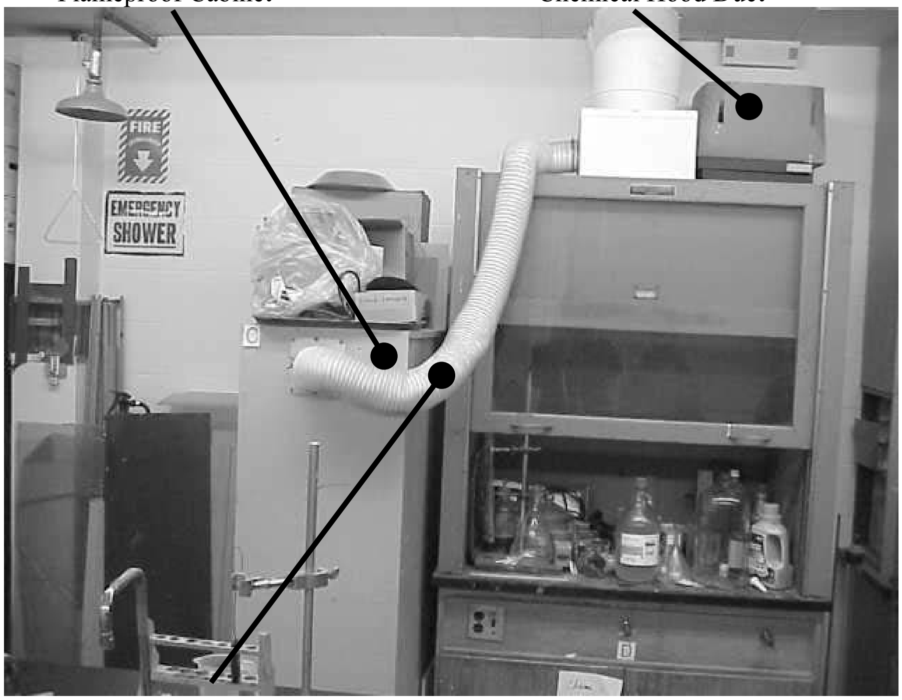
Michael A. Feeney, R.Ph., J.D., C.H.O.
Chief, Emergency Response/Indoor Air Quality Program
Bureau of Environmental Health Assessment

cc/ Suzanne Condon, Dir., BEHA
Martha Steele, Dep. Dir., BEHA
Cory Holmes, ER/IAQ, BEHA
Leonard Izzo, Hopedale Board of Health
Paul Thorp, Principal, Hopedale Junior/Senior High School

**References**

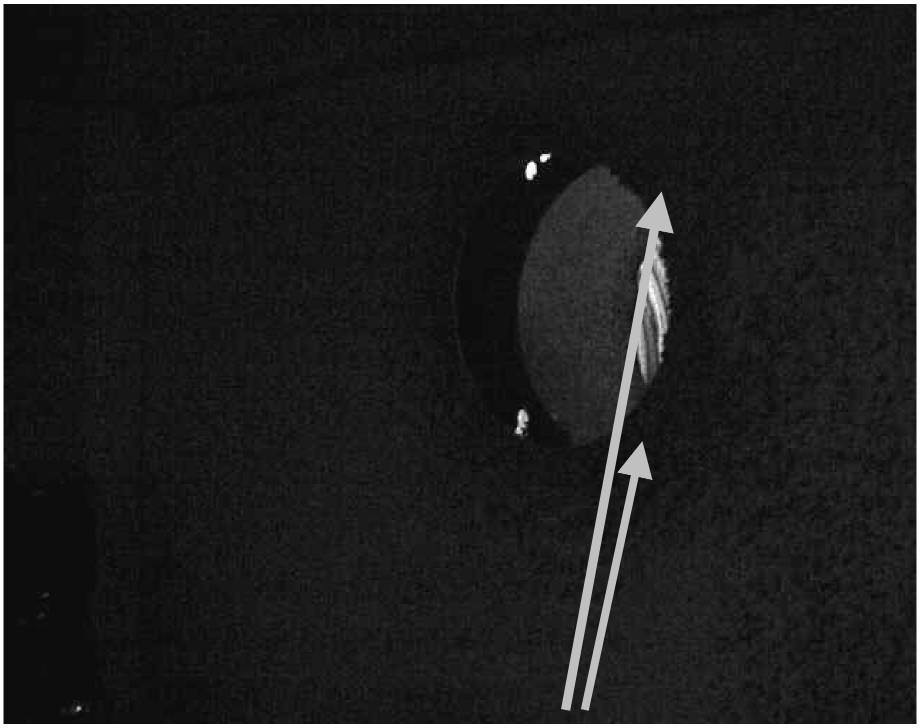
NFPA. 1996. Flammable and Combustible Liquids Code. 1996 ed. National Fire Protection Association, Quincy, MA. NFPA 30.

**Picture 1**




**Flameproof Cabinet Connected To Chemical Hood Duct by A Plastic Flexible Hose**

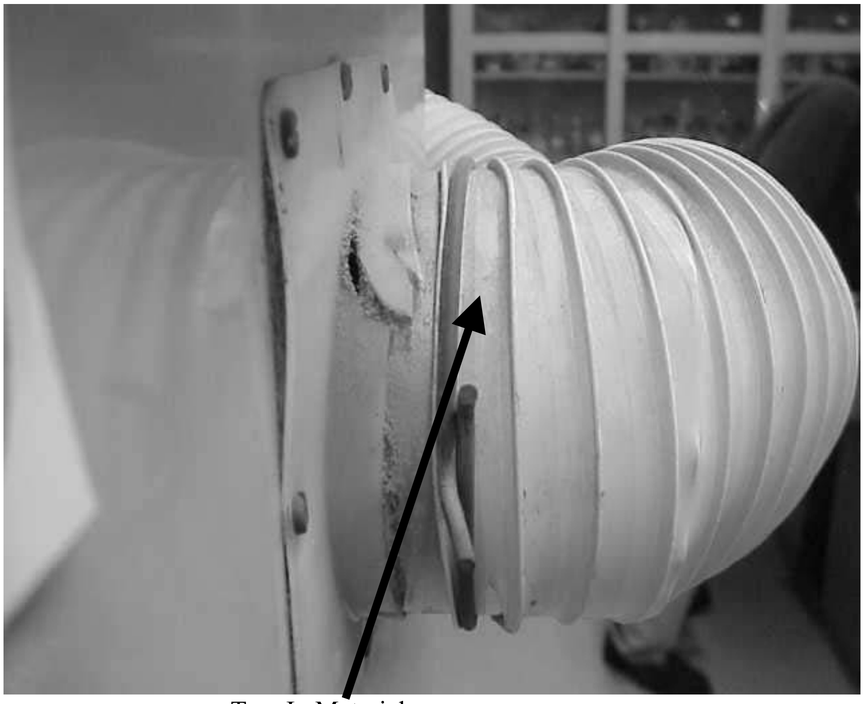
**Picture 2**



Light Spaces in Hose Connection

**Connection of Flexible Plastic Hose to Flameproof Cabinet,**
**Note Light in Connection Indicating A Breach in Integrity of Fireproof Cabinet**

**Picture 3**



Tear In Material

**Tear in Connection of Flexible Hose**

The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
Bureau of Environmental Health Assessment
250 Washington Street, Boston, MA 02108-4619



April 5, 2000

Andrea Hallion, Superintendent
Hopedale Public Schools
25 Adin Street
Hopedale, MA 01747

Dear Ms. Hallion:

At the request of a parent, the Bureau of Environmental Health Assessment (BEHA) conducted an evaluation of the indoor air quality at the Hopedale Junior/Senior High School on March 20, 2000. Cory Holmes, Environmental Analyst for BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) program, conducted the assessment. Mr. Holmes was accompanied by Leonard Izzo of the Hopedale Board of Health, and for portions of the assessment by Paul Thorp, Principal, and Phillip Painter, Clerk of the Works. Concerns about pollutants generated by renovation efforts and the potential impact on occupied areas in this building prompted this request.

As you know, the school is currently under renovation while occupied by students, teachers and school staff. The planned renovations are to the existing building including an addition of a wing at the south end of the building (see Picture 1). It was reported to BEHA staff that several indoor air quality tests had been conducted previous to this visit. During the assessment, construction activity was limited to work outside the occupied building. No measurable levels of carbon monoxide or unusual odors were detected in the building.

Spaces in temporary walls were observed (see Pictures 2 through 4). These spaces in containment areas may allow pollutants to migrate into occupied areas in the school. BEHA staff recommended that spaces around containment walls be sealed with duct tape. BEHA staff also recommended that containment walls be covered with plastic sheeting and duct tape to provide a secondary barrier.

Missing ceiling tiles were also noted in several areas, providing spaces between the decking and wall (see Picture 5) which can provide a means of egress for renovation generated pollutants to enter occupied areas. None of the open spaces created by the lack of ceiling tiles have been sealed to prevent air movement above the ceiling tiles (see Figure 1). Dust and debris can move with drafts from the unoccupied construction section to occupied areas.

Located on the eastern side of the building is the parking lot for construction vehicles. Construction vehicles that run in this area can aerosolize amounts of dirt, dust and other particulates. Operating construction vehicles also produce vehicle exhaust, which contains carbon monoxide. A number of classrooms adjacent to this area were found with open windows (see Picture 6). Some of these rooms had deactivated univents. The open windows allow unfiltered outdoor air to enter the classroom environment that may transport airborne dirt, dust and particulates. In many classrooms, accumulated dirt and dust was observed on horizontal surfaces.

A number of pathways exist for pollutants to move from areas under renovation into occupied spaces. These pathways indicate that the temporary walls are not sufficient to contain pollutants related to renovation work. The following recommendations should be implemented in order to reduce the migration of renovation generated pollutants into occupied areas and to better understand the potential for mold to impact indoor air quality:

1. Establish communications between all parties involved with building renovations to prevent potential IAQ problems. Develop a forum for occupants to express concerns about renovations as well as a program to resolve IAQ issues.

2. Develop a notification system for building occupants immediately adjacent to construction activities to report construction/renovation related odors and/or dusts problems to the building administrator. Have these concerns relayed to the contractor in a manner to allow for a timely remediation of the problem.

3. When possible, schedule projects which produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy.

4. Disseminate scheduling itinerary to all affected parties, this can be done in the form of meetings, newsletters or weekly bulletins.

5. Obtain Material Safety Data Sheets (MSDS) for all construction materials used during renovations and keep them in an area that is accessible to all individuals during periods of building operations as required by the Massachusetts Right-To-Know Act (MGL, 1983).

6. Consult MSDS' for any material applied to the effected area during renovation(s) including any sealant, carpet adhesive, tile mastic, flooring and/or roofing materials. Provide proper ventilation and allow sufficient curing time as per the manufacturer's instructions concerning these materials.

7. Use local exhaust ventilation and isolation techniques to control for renovation pollutants. Precautions should be taken to avoid the re-entrainment of these materials into the building's HVAC system. The design of each system must be assessed to determine how it may be impacted by renovation activities. Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring systems are isolated from contaminated environments, sealing ventilation openings with plastic and utilizing filters with a higher dust spot efficiency where needed (SMACNA, 1995).

8. Seal utility holes, spaces in roof decking and temporary walls to eliminate pollutant paths of migration. Seal holes created by missing tiles in ceiling temporarily to prevent renovation pollutant migration.

9. Seal construction barriers with polyethylene plastic and duct tape to create a secondary barrier to prevent migration of renovation generated pollutants into occupied areas.

10. If possible, relocate susceptible persons and those with pre-existing medical conditions (e.g., hypersensitivity, asthma) away from areas of renovations.

11. Implement prudent housekeeping and work site practices to minimize exposure to renovation pollutants. This may include constructing barriers, sealing off areas, and temporarily relocating furniture and supplies. To control for dusts, a high efficiency particulate air filter (HEPA) equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended.

12. Close windows adjacent to construction activities to prevent unfiltered air from entering the building.

13. Consider changing univent filters more regularly in areas impacted by renovation activities. Examine the feasibility of acquiring more efficient filters for these units.

14. Continue working with the school's construction contractor and consultant to monitor indoor air quality.

We suggest that these steps be taken on any renovation project within a public building. Please feel free to contact us at (617) 624-5757 if you are in need of further information or technical assistance.

Sincerely,

Suzanne Condon, Director
Bureau of Environmental Health Assessment

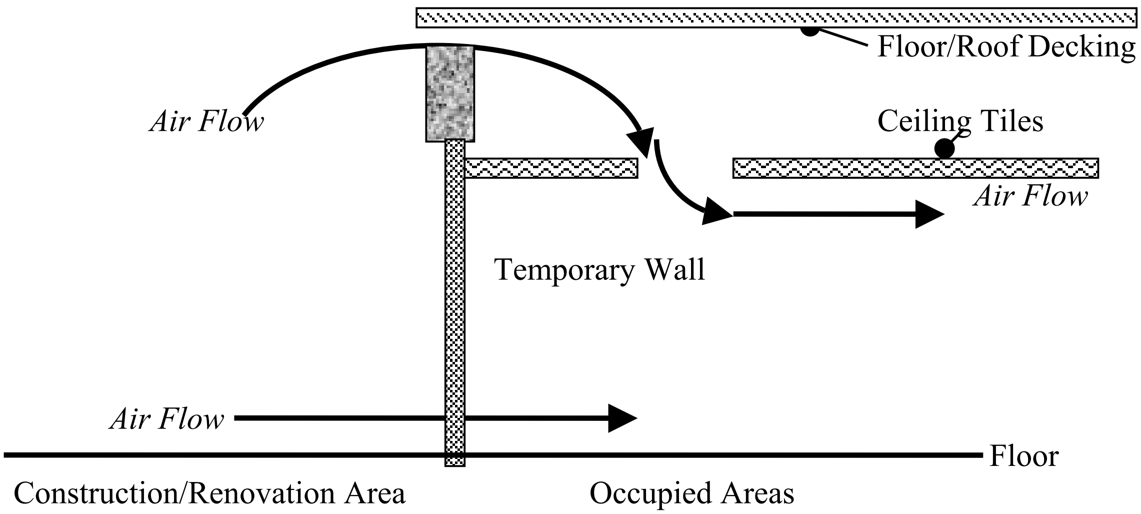
cc/ Mike Feeney, Chief, Emergency Response/Indoor Air Quality
Leonard Izzo, Hopedale Board of Health
Paul Thorp, Principal, Hopedale Junior/Senior High School
Phillip Painter, Clerk of the Works, Hopedale Public Schools

**References**

MGL. 1983. Hazardous Substances Disclosure by Employers. Massachusetts General Laws. M.G.L. c. 111F.

SMACNA. 1995. IAQ Guidelines for Occupied Buildings Under Construction. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

**Figure 1**

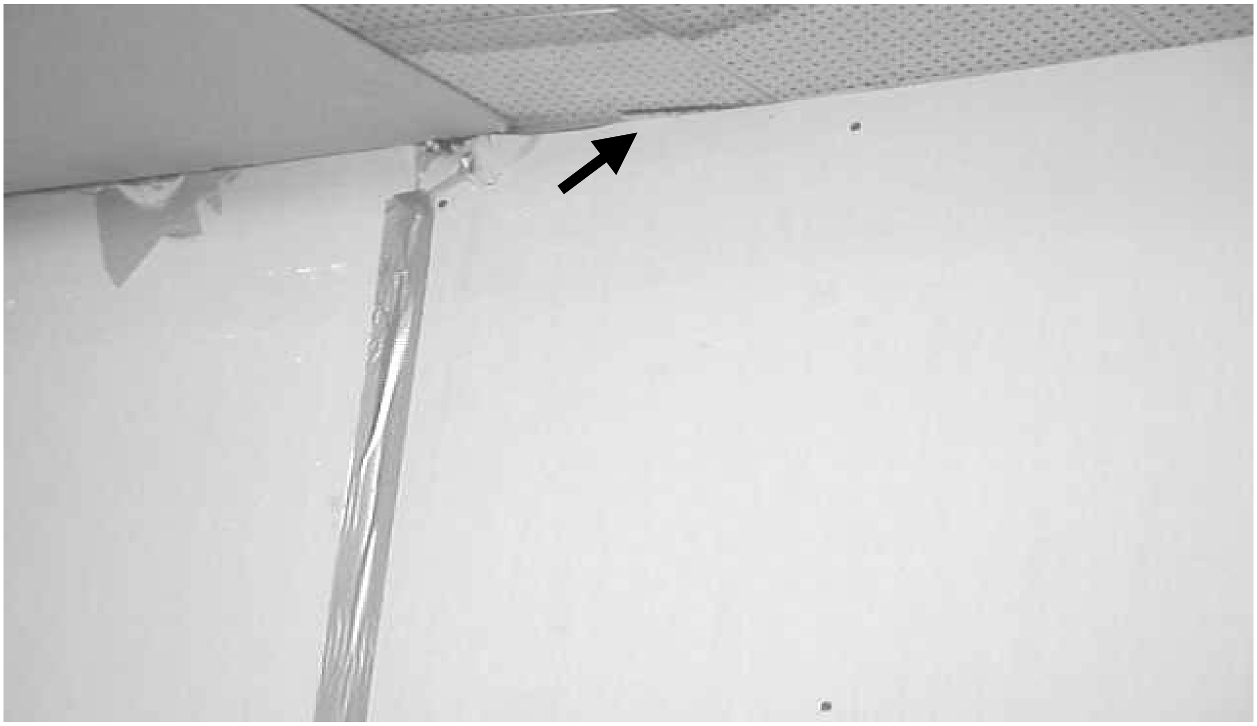



(Figure Not To Scale)

**Picture 1**

**West Side View of Hopedale Junior/Senior High School**
**Note Addition Being Built on South Side of Existing Building**

**Picture 2**

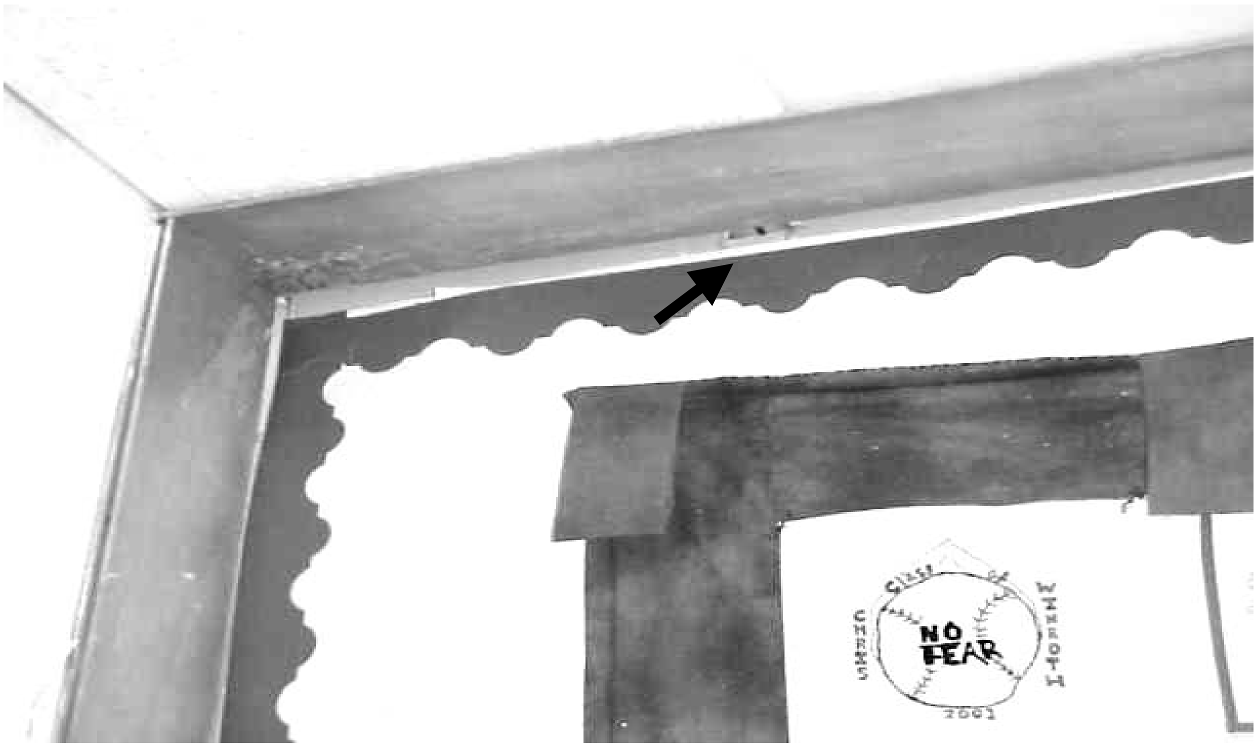


**Gypsum Board Containment Wall Erected in Classroom**
**Note the Wall/Ceiling Junction Is Not Sealed with Duct Tape**

**Picture 3**

**Spaces Noted around Plywood Containment Wall in South West First Floor Corridor**

**Picture 4**




**Hole Noted in Containment Wall Adjacent to the Ceiling**

**Picture 5**

**Missing Ceiling Tile Noted in Classroom Adjacent to the Construction Zone**

## Picture 6

**Construction Equipment Operating outside East Side Classroom with Open Window, Note of Loose Dirt**
(Picture Taken from Interior of Classroom)